

Section III (Remarks)

Amendment of the Title

In response to the objection to the specification as lacking a descriptive title, the title of the application has been amended herein to "APPARATUS AND METHOD FOR HYDROGEN GENERATION FROM GASEOUS HYDRIDE."

The new title is clearly indicative of the invention to which the claims as amended herein are directed.

Amendment of the Drawings

In response to the objection to Figure 1 as requiring designation by a legend such as Prior Art, a replacement Figure 1 is enclosed and submitted herewith.

In the replacement drawing sheet, the legend "Prior Art" is set forth beneath the figure number, and the replacement sheet of drawing is labeled "Replacement Sheet."

It is requested that the replacement sheet of drawing be entered in the application, in replacement of Figure 1 as originally filed in the application.

Amendments to the Claims

Claims 3, 9-11, 13-14, 21-22, 28, 30-31, 37, 40-41, 53, 57-59, 70-72, 74-75 and 78-79 have been canceled herein, and claims 1-2, 4-5, 7-8, 16, 18-19, 23-24, 29, 32-36, 38, 42-43, 47-52, 54-55, 60-62, 67, 73, 76, and 80-84 have been amended to direct the claimed subject matter more specifically to particular aspects and features of applicants' invention.

Claim 1 has been amended to recite the apparatus for storing and dispensing gas, in which the stored gas is specified as "comprising a gaseous hydride that is decomposable to produce hydrogen gas and a solid decomposition product," consistent with the disclosure at paragraph

[0075] at the application [NOTE: all references herein to the disclosure of the specification are directed to the text of the application is published on February 8, 2007 as US Patent Application Publication 20070031325], disclosing that "gaseous hydride materials generate hydrogen upon decomposition... by-products include a solid phase metal." The generated hydrogen gas then can be dispensed, e.g., as described in connection with Figure 2A and the appertaining text from the decomposition chamber. The membrane recited in claim 1 has been further specified as a "hydrogen gas permeable membrane," consistent with the disclosure at paragraph [0079] ("membranes... are hydrogen-selective, that is, they permeate hydrogen preferentially over gaseous hydrides and all other gases in the mix").

Claim 1 also has been amended to specify the decomposition portion of the decomposition chamber as containing "a phosphoric acid-doped carbon adsorbent effective to decompose said gaseous hydride to produce hydrogen gas for dispensing, and a solid decomposition product," consistent with the disclosure at paragraph [0058] ("[e]mpirical determinations show the occurrence of enhanced decomposition rates after doping the carbon sorbent material with phosphoric acid... [t]his enhanced decomposition... was unexpected").

The dependent claims under claim 1 have been correspondingly amended for consistency with amended claim 1, e.g., to specify a gaseous hydride as the gas that is decomposed in the decomposition chamber to form hydrogen gas.

In claim 18, the interior gas pressure in the storage and dispensing vessel is recited as "superatmospheric" pressure, consistent with the disclosure in paragraph [0066] ("subatmospheric, atmospheric or superatmospheric pressure").

The claims withdrawn from further consideration in the September 17, 2009 Office Action have been amended to depend from or otherwise incorporate the substance of the elected claims 1-27, in order to facilitate rejoinder of the withdrawn claims. For example, independent claim 28 has been canceled and the dependent claims around or have them amended to depend from claim 27. Independent claim 36 has been rewritten in dependent form under claim 1. Independent method claim 50 has been rewritten to recite, inter alia, "providing an apparatus according to claim 1" in order to facilitate rejoinder under the provisions of MPEP 821.04, as has independent method

claim 73, and the withdrawn independent apparatus claim 84 has been rewritten in dependent form under claim 1.

Accordingly, the withdrawn claims 29, 32-36, 38-39, 42-52, 54-56, 60-69, 73, 76-77, and 80-84 are requested to be rejoined with elected claims 1-2, 4-8, 12, 15-20, and 23-27 and concurrently allowed with such elected claims.

The amendments made herein are fully consistent with and supported by the originally-filed disclosure of this application. No new matter within the meaning of 35 U.S.C. §132(a) has been introduced by the foregoing amendments.

Error in Double Patenting Rejection

It is noted that an error has been made in the rejection of claim 1 on non-statutory obviousness-type double patenting grounds, since the cited reference, US Patent 6,176,271, does not in any way relate to the subject matter disclosed and claimed in the present application. Such cited reference is directed to fabric seams.

Since the cited reference is stated to claim a storage and dispensing vessel with a sorbate gas and a physical sorbent medium, it is evident that an error has been made in the citation. Accordingly, it is requested that the obviousness-type double patenting rejection of claim 1 based on US Patent 6,176,271 be withdrawn

Claim Rejections on 35 USC 102/103 Grounds, and Traversal Thereof

In the September 17, 2009 Office Action, the previously pending elected claims 1-27 were rejected on reference grounds, including:

a rejection of claims 1-7, 9, 10, 13, 14 and 16-27 under 35 U.S.C 102(b) as being anticipated by Hultquist (US 6,132,492);

a rejection of claims 8 and 11 under 35 U.S.C. 103(a) as being unpatentable over Hultquist as applied to claims 1 and 9, respectively; and

a rejection of claims 12 and 15 under 35 U.S.C. 103(a) as being unpatentable over Hultquist as applied to claim 2, and further in view of Keefer (US 2002/0112479 A1).

These rejections are being traversed, in application to the claims as now amended. Consideration of the patentability of the newly amended claims is requested, in light of the following remarks.

Patentability of Claims 1-2, 4-8, 12, 15-20, 23-27, 29, 32-36, 38-39, 42-52, 54-56, 60-69, 73, 76-77, and 80-84

By way of background, claim 1 as amended is directed to an apparatus for storing and dispensing gas, including a storage and dispensing vessel for containing gaseous hydride, and a decomposition chamber including a decomposition portion containing a phosphoric acid-doped carbon adsorbent effective to decompose the gaseous hydride to produce hydrogen gas for dispensing. The invention therefore provides an advantageous arrangement for in situ generation of hydrogen gas for use in applications such as portable fuel cell power supplies.

The decomposition absorbent, a phosphoric acid-doped carbon adsorbent, has been found to provide enhanced decomposition of gaseous hydride, e.g., germane, stibine, silane, phosphine, arsine, diborane, etc., for rapid, on-demand hydrogen production.

Such utility of a phosphoric acid-doped carbon adsorbent is wholly unexpected, as discussed in paragraph [0058] of the application, since McKee (Carbon, 22(6), 507 (1984)) discloses that graphite oxidation is inhibited by phosphorus additives, and therefore decomposition promotion with a phosphorus-containing compound on a carbon substrate would not be expected to occur.

The claimed invention therefore enables high rate, on-demand hydrogen gas generation, in a manner wholly unexpected by the prior art, which teaches away from applicants' claimed invention.

In the September 17, 2009 Office Action, all of the then-pending claims under examination were rejected on anticipation or obviousness grounds over Hultquist USP 6,132,492, with claims 12 and 15 rejected over Hultquist in view of Keefer (cited for disclosure that hydrogen fuel for a fuel cell can be supplied from hydrogen adsorbed on a physical adsorbent). Thus, all rejections of claims rely on Hultquist as a sole or primary reference.

Hultquist describes use of a capsule containing hydrogen-selective getter and having a hydrogen-permeable membrane, so that undesired hydrogen generated from a hydride gas in a sorbent-containing vessel diffuses into the getter capsule and is irreversibly chemisorbed. This is opposite to the approach of applicants' claimed invention, in which hydrogen gas is purposefully generated, for dispensing.

Hultquist has been cited (page 5, paragraph 16 of the September 17, 2009 Office Action) as disclosing phosphoric acid-doped carbon adsorbent at column 13, lines 40-61, but such cited passage of Hultquist contains no mention of any such adsorbent, nor is there any other disclosure in the Hultquist reference that in any way describes, suggests or provides any basis for a phosphoric acid-doped carbon adsorbent. As substantiation of such lack of disclosure in Hultquist, the cited text at column 13, lines 40-61 is reproduced below in its entirety:

"For such purpose, the chemisorbent may be isolated or shielded from the sorbate gas to be dispensed, by being placed in the vessel in an isolation structure containing the chemisorbent, in which the isolation structure includes a membrane or other physical barrier which is permeable to the impurity species but is impermeable to the sorbate to be held on the sorbent material for subsequent discharge as the product gas from the storage and dispensing vessel.

The chemisorbent may therefore be provided in a capsule or other container which is physically reposed in the interior volume and which is permeable only to the impurity gas species.

For example, the container or restricted area of the interior volume of the vessel may have a permselective membrane shielding the chemisorbent and only permeable to the impurity species.

The membrane may be formed of a wide variety of potentially useful materials, including, for example, polypropylene, polyvinylidene fluoride, polytetrafluoroethylene, polyfluoroacetate, silicone, surface-treated glass fabrics, and Noryl[®] polyphenylene oxide film (General Electric Company, Pittsfield, Mass.).” - Hultquist, column 13, lines 40-61

While Hultquist does disclose ion implantation of phosphorus ions into a polysilicon substrate (column 8, lines 10-15), there is no mention of phosphorus-doped adsorbents, and no mention of phosphoric acid anywhere in such reference.

Thus, Hultquist provides no derivative basis for applicants’ claimed invention, as broadly set forth in claim 1, in relation to which all other pending claims are either dependent thereunder or else incorporate the subject matter of such claim 1. The further Keefer teachings relating to supplying hydrogen as fuel to a hydrogen fuel cell likewise do not in any way relate to a phosphoric acid-doped carbon adsorbent, much less the use of such a phosphoric acid-doped carbon adsorbent for effecting rapid, on-demand hydrogen production from gaseous hydrides, and as has been pointed out, the prior art, as exemplified by McKee et al., in fact teaches away from the applicants’ claimed invention.

Accordingly, claims 1-2, 4-8, 12, 15-20, 23-27, 29, 32-36, 38-39, 42-52, 54-56, 60-69, 73, 76-77, and 80-84 possess a clear basis for distinction over the cited references, and over the prior art generally.

It therefore is requested that all pending claims be allowed, subsequent to rejoinder of the withdrawn claims 29, 32-36, 38-39, 42-52, 54-56, 60-69, 73, 76-77, and 80-84, with the elected claims 1-2, 4-8, 12, 15-20 and 23-27.

Fee Payable for Extension of Time

The fee of \$130 specified in 37 CFR 1.17(a) for the one-month extension of the term for reply to the September 17, 2009 Office Action, is being paid by online credit card authorization at the time of EFS filing of this response.

Authorization also is hereby given to charge the amount of any deficiency in fees properly payable for this response, to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

CONCLUSION

Based on the foregoing, all of Applicants' pending claims are patentably distinguished over the art, and in form and condition for allowance. Rejoinder of the withdrawn claims 29, 32-36, 38-39, 42-52, 54-56, 60-69, 73, 76-77, and 80-84 is requested, under the provisions of MPEP 821.04. The examiner is requested to favorably consider the foregoing, and to responsively issue a Notice of Allowance for claims 1-2, 4-8, 12, 15-20, 23-27, 29, 32-36, 38-39, 42-52, 54-56, 60-69, 73, 76-77, and 80-84. If any issues require further resolution, the examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same, in order that the application may be passed to issue, at an early date.

Respectfully submitted,

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